

NON-PUBLIC?: N

ACCESSION #: 9410130343

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Millstone Nuclear Power Station Unit 3 PAGE: 1 OF 7

DOCKET NUMBER: 05000423

TITLE: Manual Reactor Trip Due to Main Steam Isolation Valve
Failure During Part-Stroke Test

EVENT DATE: 09/08/94 LER #: 94-011-00 REPORT DATE: 10/07/94

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100%

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10
CFR SECTION:

50.73(a)(2)(i)

50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: William J. Temple, Nuclear Licensing TELEPHONE: (203) 437-5904

COMPONENT FAILURE DESCRIPTION:

CAUSE: B SYSTEM: SB COMPONENT: ISV MANUFACTURER: S452

E BA 65 W290

B SB RV D243

REPORTABLE NPRDS: Y

Y

Y

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On September 8, 1994, with the plant at 100% power, a manual reactor trip was initiated. The reactor was manually tripped in anticipation of an automatic trip, due to the "C" Main Steam Isolation Valve (MSIV) failing closed during surveillance testing. The plant responded normally with the exception that two of the Main Steam safety valves appeared to open momentarily below the Technical Specification tolerance. Feedwater isolation occurred. The auxiliary feedwater pumps started on Low-Low Steam Generator level, and the turbine-driven Auxiliary Feedwater pump tripped off eight seconds after starting.

The manual trip of the reactor protection system is reported under 10CFR50.73(a)(2)(iv). The Main Steam safety valves lifting below their Technical Specification tolerance is reported under 10CFR50.73(a)(2)(i)(B) as a condition prohibited by Technical Specifications.

The cause of the MSIV closure was equipment failure. A pin failed in a solenoid on the "C" MSIV, which resulted in the MSIV failing closed during surveillance testing. The cause of the Main Steam safety valves lifting prematurely is believed to be due to setpoint drift.

As immediate corrective action the control room Operators manually tripped the reactor and performed the actions required by emergency operating procedures. As corrective action, the solenoid and a number of

pins were replaced, and the MSIVs were tested satisfactorily. The turbine-driven Auxiliary Feedwater pump was returned to operable status, and two Main Steam safety valves were replaced.

END OF ABSTRACT

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I. Description of Event

On September, 8, 1994, at 13:55, with the plant at 100% power (586 degrees Fahrenheit and 2250 psia) a manual reactor trip was initiated. The reactor was manually tripped in anticipation of an automatic trip, because the "C" Main Steam Isolation Valve (MSIV) had failed closed during testing. The plant responded normally with the exception that two of the "C" Main Steam safety valves appeared to open momentarily below the Technical Specification tolerance. The plant was placed in a stable condition. Feedwater isolation occurred and the auxiliary feedwater pumps started on Low-Low Steam Generator level as expected. The turbine-driven Auxiliary Feedwater pump tripped on overspeed eight seconds after starting. No other Engineered Safety Features Actuations were required or initiated.

The arrangement of solenoid valves for actuating an MSIV is shown in the attached Figure 1. A partial-stroke test is performed on a MSIV by deenergizing (opening) the 2A and 2B solenoids associated with the MSIV to allow steam to be admitted to the top of the main operating piston. At the same time the vent paths are closed by deenergizing the 1A and 1B solenoids. After completing a partial stroke, the 2A and 2B solenoids are reenergized (closed) to stop the

pressurization of the top of the main piston. At the same time the 1A and 1B solenoids are reenergized to vent the steam, thereby allowing the MSIV to fully open.

The plant was at 100% power while partial-stroke testing was being performed on the MSIVs. The 2A and 2B solenoids of the "C" MSIV had failed a number of stroke tests when the solenoid pin broke and the valve failed closed at 13:55 hours. A decision had previously been made to commence shutdown by 14:00. The Unit had entered Technical Specification LCOs 3.6.3.a and 3.7.1.5. Several unexpected conditions occurred during the last test and were observed at the test panel. The off-normal conditions consisted of the alarm going off on the test panels, an unusual voltage reading on the 2B solenoid, and an annunciator for Auxiliary Circuit Trouble. The control room operator noticed the valve partly closing twice then fully closing. After checking for "steam flow decreasing" the reactor was manually tripped within two seconds.

The Operators carried out the actions of Emergency Operating Procedures for Reactor Trip/Safety Injection. No Safety Injection was required and the Operators transited to the procedures for Reactor Trip Recovery and Turbine Trip. The Operators started losing condenser vacuum due to loss of gland sealing steam. Gland sealing steam was restored by opening the bypass valve then isolating the unloader valve. The Operators used procedures for Secondary Chemistry in response to high Sodium/Conductivity in the Hotwell. The indications were caused by the degraded condenser vacuum.

During the trip, three of the "C" Main Steam Safety valves lifted

momentarily, two of them below the Technical Specification tolerance of 1%. All valves immediately reseated. The five safety valves on the "C" Steam Line are nominally set at 10 psi increments: 1185, 1195, 1205, 1215, and 1225 psi. The lowest valve lifted, and indications are that the two highest valves also may have lifted. Pressure instrumentation indicates that pressure reached approximately 1185 psi, but not high enough to lift the 1195 and 1205 valves. Thus, the two highest valves lifted below the Technical Specification tolerance of 1%. No immediate action was required, as the reactor had been manually tripped and the plant was proceeding to shutdown.

During restoration, the Operators noted that the turbine-driven Auxiliary Feedwater pump had tripped. However, either of the two operating motor-driven Auxiliary Feedwater pumps provided more than adequate flow.

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II. Cause of Event

The cause of the "C" MSIV closure was equipment failure. A pin failed in the #2B solenoid on the MSIV, which resulted in the MSIV failing closed during surveillance testing. The solenoid indicated open to a greater value than expected due to the mechanical pin failure. The #4 solenoids have also experienced mechanical pin failures in the past. The shear forces on the pins are greatest on the #1 and #4 solenoids when energizing open. The forces applied when opening the #2 and #3 solenoids are approximately a factor of three less. The plant has not experienced any indication of high

shear forces on the #2 and #3 solenoids in the past. Additional details describing the pin failures and SOV operation has been submitted to the NRC under separate correspondence, related to a proposed Technical Specification change on the MSIV stroke time. This is described in more detail in the Additional Information section below.

The cause of the two Main Steam safety valves lifting below the Technical Specification tolerance, is believed to be setpoint drift. This is a recurring condition in the industry. The valves have been sent to a testing facility to confirm their actual lift settings.

The cause of the turbine-driven Auxiliary Feedwater pump overspeed trip after eight seconds was attributed to a sticking control valve stem and/or linkage between the control valve and governor. This resulted in the governor admitting excess steam on startup, causing an overspeed trip.

III. Analysis of Event

The "C" MSIV failing closed is reported under 10CFR50.73(a)(2)(iv), as an event or condition that resulted in a manual actuation of the reactor protection system. Immediate notification was performed in accordance with 10CFR50.72(b)(2)(ii) and 50.72(b)(2)(vi).

The safety significance of the event was minimal as the trip was manually initiated as a result of the "C" MSIV failing closed during the partial - stroke surveillance testing. This was a fail-safe position for the MSIV.

Partial Stroke testing was being performed on the MSIVs. The following conditions were noted prior to the failure of solenoid #2B:

Performance of partial -stroke tests on both trains of the "C" MSIV were unsuccessful due to long stroke times of the #2 solenoids. The solenoid stroke times were in the range of 1.11 to 1.59 seconds, whereas the acceptance criterion is 1.1 seconds or less.

On the last test prior to the closure of the "C" MSIV, the 2B solenoid trace, indicating SOV stem travel, showed 12.5 volts versus the normal 10 volts, which indicated potential mechanical failure in the solenoid.

The 2B solenoid failed to close during the reopening sequence of the partial-stroke test. This resulted in the continued pressurization of the upper portion of the main valve piston, thereby closing the MSIV. The failure of the pin in the 2B solenoid of the "C" MSIV did not have an adverse safety consequence since the pin failure did not prevent the MSIV from closing in the fail-safe closed position. All other solenoids performed satisfactorily.

The Main Steam safety valves lifting below their Technical Specification tolerance is reported under 10CFR50.73(a)(2)(i)(B) as a condition prohibited by Technical Specifications. LCO Table 3.7-3 requires that all Steam Line Safety Valves lift at 1% of the lift setting. This condition had low safety significance. The valves lifted within the 3% assumed in the FSAR Accident Analysis.

Setpoint drift on Main Steam Safety valves is a recurring industry condition.

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IV. Corrective Action

As immediate corrective action for the "C" MSIV failing closed, the control room operators manually tripped the reactor within two seconds, and performed the actions required by the emergency operating and plant shutdown procedures.

The following corrective actions were performed during the outage:

The #2A and 2B solenoids on the "C" MSIV were replaced, and the MSIVs were tested satisfactorily.

A number of pins were replaced because it was initially suspected that SOV strokes were a limiting factor for pin failures. However, it was subsequently determined that there was no correlation between SOV strokes and pin failures, as described in the Additional Information section below:

The turbine-driven Auxiliary Feedwater pump control valve to governor linkage was disassembled, cleaned, and lubricated, and the control valve stem was lubricated. Cold startup and response time testing of the turbine was performed during plant startup from the outage, and the pump was returned to OPERABLE status.

Two of the "C" Main Steam safety valves that may have lifted below their Technical Specification limits (1%) during the plant trip, were replaced. They have been sent to a testing facility to confirm their actual lift settings.

As action to prevent recurrence of the MSIV solenoid pin failures, NNECO is working with the valve supplier to evaluate the pin material, fabrication, and possible design changes, to minimize potential recurrence of pin failures. An OPERABILITY determination on the MSIVs has also been conducted, by addressing Technical Specification requirements, reliability assurance testing, design/failure modes, single failure, operating experience, probabilistic risk assessment, operating experience on slow stroke times, and FSAR design basis and safety analysis. The results confirm that the MSIVs are OPERABLE.

As action to prevent recurrence of the turbine-driven Auxiliary Feedwater pump over-speed trip, preventative maintenance will be established to perform required cleaning and lubrication, and to verify proper operation of the governor output linkage. A preventative maintenance schedule will be established for the steam traps upstream from the normally closed steam supply valves. Cold start testing will be performed on an increased frequency, and gradually extended to the normal quarterly surveillance intervals. The surveillance procedure has been changed to perform the cold start tests with all three steam admission valves.

As action to prevent recurrence of the Main Steam safety valves being outside of the Technical Specification tolerance, a relaxation

of the 1 % tolerance has been pursued. A request to change the Technical Specification Table 3.7-3 tolerance to 3% was submitted to the NRC on August 4, 1994.

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V. Additional Information

The turbine gland seal pressure regulator, which was overridden closed and contributed to the loss of the condenser vacuum, was repaired, and will be modified to improve reliability during the 1995 refueling outage.

It has been determined that there is no correlation between the MSIV solenoid pin failures and the number of solenoid strokes. However, in order to provide more margin on MSIV testing, a proposed Technical Specification change was submitted to the NRC on September 9, 1994. NNECO has responded to NRC questions raised, by supplying additional details on pin failures and SOV operation in a letter dated October 5, 1994. The change proposes to increase the allowed MSIV stroke time from 5 seconds to 10 seconds. In practice, 1.1 seconds of the 5-second Technical Specification is allocated for the solenoid response, and 3.9 seconds is allocated for the MSIV stroke, once steam is admitted to the top of the piston. The 1.1 -second allocation has been overly restrictive, because even with optimum solenoid performance, there is typically less than one-half second of margin available. This tight margin has historically required additional stroke cycles and caused difficulty meeting the 1.1 -second response time. A safety analysis shows that a 10-second MSIV closure time is acceptable. This change, when approved, would allow

future partial-stroke testing of the MSIVs to be performed with an appropriate acceptance criterion allocated for the solenoid stroke.

After the plant trip, a separate reportable issue was identified. An inspection inside containment revealed a small pressure boundary leak in a reactor coolant loop instrument line socket weld. An Unusual Event declaration was reported to the NRC. That event is being separately reported as LER 94-012-00.

During the plant outage it was determined that a change to the Technical Specification would be needed to allow the plant to enter Mode 4 and Mode 3 as necessary to perform the required OPERABILITY tests for the MSIVs and the turbine-driven Auxiliary Feedwater pump. Enforcement discretion was granted by the NRC to allow the plant to do the OPERABILITY testing and start up the plant. The Technical Specification change was issued by the NRC on September 29, 1994. It was determined by plant personnel that this generic issue is applicable to all startups, and it is being separately reported as LER 94-013-00.

Previous MSIV failures were reported in LERs 88-23-00 and 87-27-00:

In LER 88-23-00, "Reactor Trip Due to Low Steam Generator Level Due to Main Steam Isolation Valve Closure," the "C" MSIV closed during a partial-stroke surveillance. This resulted in a reactor trip due to low- low level in the "C" Steam Generator. The cause was an inadequate procedure which did not identify the bypassing of attenuators so that full voltage could be applied to the solenoids. As corrective action the procedure was changed. The cause and corrective action were not related to the current event.

In LER 87-27-00, "Reactor Trip Due to Loss of Vital Bus," it was noted that the "A" MSIV failed a stroke test after a reactor trip due to a 2B solenoid failure. The solenoid failed due to rubbing caused by run-out of the valve piston rod, and by a small air gap that increased the magnetic coupling between the solenoid plunger and armature. The cause and corrective action were not related to the current event.

The MSIVs, including their solenoids and pins, are provided by Sulzer Thermtec AG, Winterthur, Switzerland. NNECO believes that Millstone Unit 3 is the only U.S. plant having MSIVs supplied by Sulzer. The information provided in this LER fulfills any other reporting obligations of 10CFR Part 21.

Previous LERs for setpoint drifts of Main Steam Safety Valves are 93-011-00, 91 -002-00, 89-010-00, and 87-036-00.

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EIIS Codes

System

Main Steam System - SB

Auxiliary Feedwater System - BA

Components Isolation Valve - ISV

Solenoid - SOL

Relief Valve - RV

Governor - 65

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Figure 1 "MSIV Solenoid Arrangement" omitted.

ATTACHMENT TO 9410130343 PAGE 1 OF 1

Northeast

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The Northeast Utilities System

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Re: 10CFR50.73(a)(2)(iv)

10CFR50.73(a)(2)(i)(B)

October 07, 1994

MP-94-575

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Reference: Facility Operating License No. NPF-49
Docket No. 50-423
Licensee Event Report 94-011-00

This letter forwards Licensee Event Report 94-011-00 required to be submitted within thirty (30) days pursuant to 10CFR50.73(a)(2)(iv), an event or condition that resulted in manual actuation of the Reactor Protection System; and pursuant to 10CFR50.73(a)(2)(i)(B), a condition prohibited by Technical Specifications.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

FOR: Donald B. Miller, Jr.
Senior Vice President - Millstone Station

BY: Gary H. Bouchard
Millstone Unit 2 Director

DBM/RLM:ljs

Attachment: LER 94-011-00

cc: T. T. Martin, Region I Administrator

R. D. Swetland, Senior Resident Inspector, Millstone Unit Nos. 1, 2,
and 3

V. L. Rooney, NRC Project Manager, Millstone Unit No. 3

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